PEST MANAGEMENT ALLIANCE PROJECT
FINAL REPORT

A REDUCED-RISK PEST MANAGEMENT PROGRAM FOR WALNUTS – YEAR 5
(JANUARY 1, 2003-DECEMBER 31, 2003)

AGREEMENT NUMBER 01-0195C

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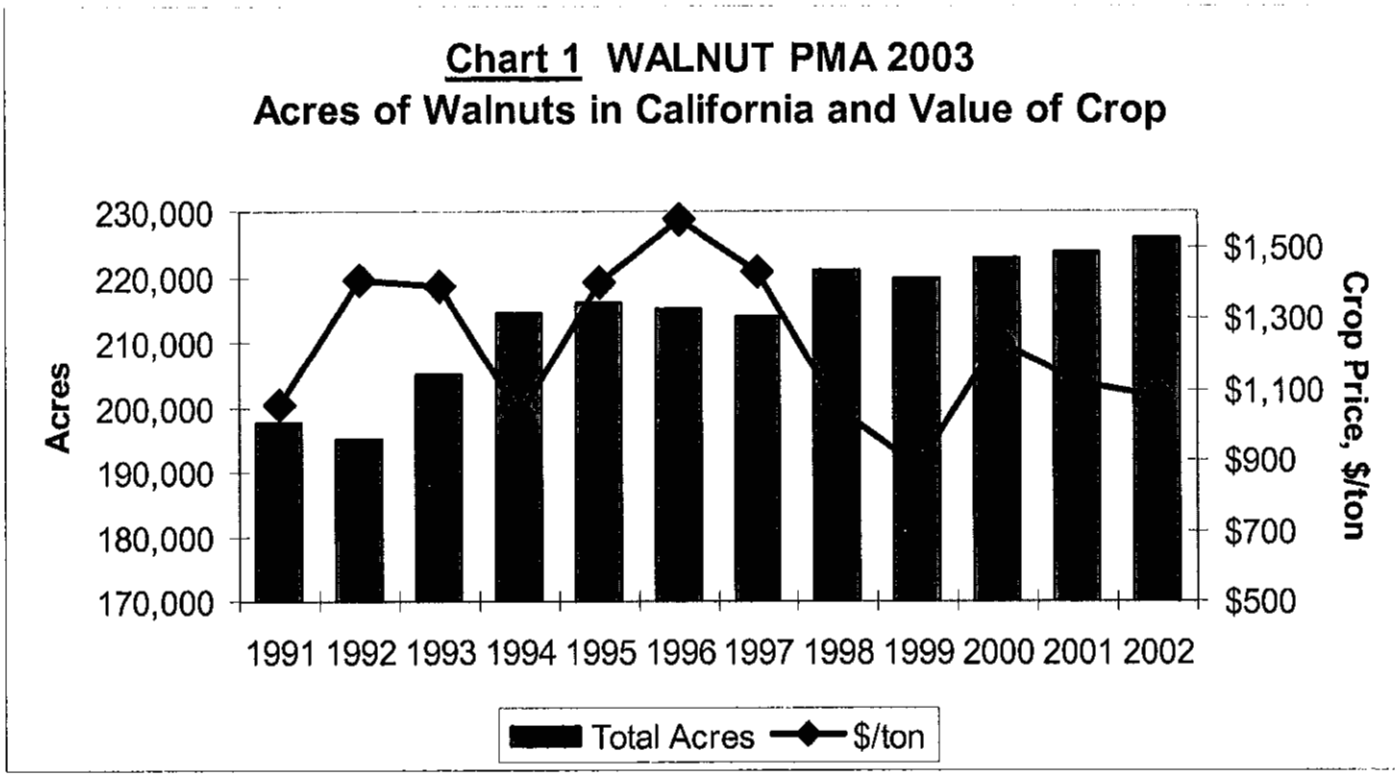
EXECUTIVE SUMMARY

Initially funded by the California Department of Pesticide Regulation (DPR), the Walnut Pest Management Alliance (PMA) has completed five years of research and field demonstration. The partners in this project are the Walnut Marketing Board, UC Cooperative Extension, California Alliance for Family Farmers, UC and USDA researchers, industry leaders, PCAs, and growers.

The Walnut PMAs five years of successful reduced-risk trials and extension of information illustrate that walnuts can be grown using a reduced risk pest management program without additional damage to the crop. During this time (1998-2003), the California walnut industry has reduced its annual use of pesticides by almost 1.5 million pounds, which is a 36% reduction in total pounds applied, showing a true commitment by the Walnut industry, the University, and the walnut growers. Planted acres of walnuts continue to steadily increase while crop prices have not recovered since the most recent high price in 1996, of $1580.00 per ton, Chart 1.



The walnut PMA work continues with the broad-based focus of continuing current efforts to develop and demonstrate reduced-risk management strategies on walnuts and to improve communication and cooperation among different groups involved in refining and implementing economical reduced-risk walnut production. The PMA project has evolved into a broader program than originally envisioned with individual researchers working closely with the PMA in the area of codling moth and walnut blight. This research enhances the project by allowing the PMA to better focus on testing and demonstration of new materials and technology that are near term. The Walnut PMA has had success with codling moth management using pheromone

mating disruption in standardized, replicated trials as well as increasing acreage of grower implementation sites.

Several factors have increased the prospects for development of reduced-risk practices for codling moth, which is the primary target for broad-spectrum insecticides in walnuts. These factors include the documentation of resistance to the most commonly used insecticides and the development of newer pheromone application technologies such as sprayable pheromone and puffers. This, coupled with the development of new, more selective insecticides that can help provide control without disruption of naturally occurring biological control.

Blight researchers have designed a walnut blight model, Xanthocast, which the PMA has been able to field test for growers in designated demonstration sites. The model uses daily climate data to increase the accuracy of spray timing, with the goal of reducing the number of blight treatments applied, while still controlling the spread of walnut blight.

The PMA will continue to develop management techniques from research funded by the Walnut Marketing Board, using UC IPM monitoring programs refined by the walnut PMA, and outreach programs that will result in increased adoption of reduced-risk walnut programs to further reduce the use of pesticides in walnuts.

INTRODUCTION

The primary goal of the fifth year of the Walnut PMA was to focus on standardized treatments using reduced-risk techniques with an emphasis on implementation by the grower. Building on the data collected from the first four years, we continued to refine the methodology for the use of reduced-risk pest management in walnuts. Field-testing and demonstration, as well as educational outreach, are the primary ways to extend this information to growers. To define the goals of the project, there were seven objectives: (1) to build upon the teamwork structure between the University of California Cooperative Extension, BIOS, California DPR, University Researchers, Industry leaders, PCAs, and growers, (2) to demonstrate control of codling moth using reduced risk practices, (3) to refine reduced-risk practices to control blight, (4) demonstrate the feasibility of cover crops, (5) monitor for additional pests, (6) show the economic impact of a reduced-risk program, and (7) show pesticide use history in commercial walnuts. The PMA is multi-faceted program that encompasses various technologies in order to assist the walnut industry to adopt reduced-risk strategies.

Objective 1: Continue to build upon the Walnut Pest Management Alliance Team for implementation of reduced-risk strategies and extend the information to growers.

The Management Team is responsible for directing and implementing reduced-risk strategies as well as designing standardized treatments. The Team incorporates the various stakeholders into the program and seeks new ideas constantly. By meeting throughout the year to plan, coordinate, and share data and new ideas, the Management Team is able to work effectively and efficiently to ensure that the PMA gathers the most scientifically reliable and easy to interpret results. Extending information is an important part of this project. At field meetings, a wide variety of information can be presented in one arena and growers and other interested parties are able to participate in the process.

Objective 2: Demonstrate IPM strategies to control codling moth, *Cydia pomonella.*

In 2003, the walnut PMA continued to refine and evaluate reduced risk methods for pest control in walnuts, specifically, pheromone-based mating disruption for codling moth management. In the 2002 season, the walnut PMA saw no significant difference in harvest damage between rates, so it made economic sense to try the lowest rates. In order for pheromone mating disruption to become adopted on significant walnut acreage, the application method must be economically realistic for a commercial grower. In 2003, the trials used very low rates of pheromone with the objective of economical viability for the grower.

Standardized treatments were replicated in five locations, two in San Joaquin County and one each in Tehama, Yuba, and Butte Counties. All orchards were the Vina variety, which is known to be codling moth susceptible. The replicated trials included treatments of Suterra's CM-F at 10 grams a.i./acre and at 5 grams a.i./acre, and an untreated control. Suterra donated the product, as well as lures to monitor CM populations.

Treatments were approximately ten acres each, and the untreated control blocks were approximately one acre. Each orchard was monitored with traps weekly from biofix to harvest and the trap liners were changed as necessary. Each treatment block had at least three Trece Delta Traps each with a different lure. The traps were as follows: one trap hung low with a Suterra 1X Biolure, and two hung high in the canopy, one with Suterra's 10x Biolure, and one with Trece's new DA kairomone lure. The lures were changed according to the manufacturer's instructions, about every 4 weeks for the 10X lure and 8 weeks for the 1X and DA lures

Five trees were selected in the center row of each treatment and monitored for damage assessment throughout the season. The overwintering generation was monitored by nut drop, recording the total number of codling moth damaged dropped nuts, and subsequent generations were monitored by canopy counts. Two methods of monitoring for damage in the canopy were compared for accuracy and ease of use, first recording the damage in 50 nuts low and 50 nuts high with the use of a ladder, and second, a search from the ground of 30 nuts each on 20 trees. The in-season damage monitoring is very important in pheromone-disrupted orchards because it allows the grower to apply a supplemental insecticide if the damage readings are high enough. In addition, canopy counts can predict damage at harvest. The harvest evaluation was collected from the same five trees, and consisted of a 100-nut harvest sample from each of the trees. Harvest damage data was also collected from the grower standard in the same orchard. The grower standard consisted of the growers normal farming practices which could include organophosphate and pyrethroid use.

To encourage large-scale implementation, the PMA began implementation or 'Value Added' demonstration sites with pheromone-treated blocks ranging from 10-25 acres. There were 18 implementation sites, with six each in the Sacramento Valley, the Southern San Joaquin Valley, and the Northern San Joaquin Valley. Treatment was limited to an application of CM-F at 5 grams a.i./acre any time the grower applied a product to control codling moth. Pest management decision making was the responsibility of the PCA and grower. UCCE staff surveyed for in-season damage to limit the possibility of economic loss to the grower.

Objective 3: Demonstrate IPM strategies to control walnut blight, *Xanthomonas campestris*.

The PMA and University of California Farm Advisors conducted three trials to further field-test the Xanthocast walnut blight model and to evaluate it for clarity and ease of use by growers and researchers. The Xanthocast model was updated daily, and available at no cost at www.Fieldwise.com. There were a total of three treatments in the blight trial: (1) a Manex and Copper treatment at 2% pistillate bloom, then sprays following the Xanthocast model, (2) the growers' standard practice, and (3) the untreated control with no sprays of Manex or Copper.

Objective 4: Demonstrate the impact of a replanted cover crop, a naturally reseeding cover crop, and native vegetation.

A cover crop planted four years ago in Yuba County was replanted in December 1999 to augment reseeding after an herbicide application prevented some of the planted species from reseeding in the middle of the rows. Sampling of plant species present in the PMA and grower standard was conducted in early May each year from 2000 to 2002. In 2003, the cover crop was mowed before a survey could be conducted. The sampling was done on a presence/absence basis, recording only whether species were present, not the number of each. UC weed ecologist Anil Shrestha analyzed the data.

Objective 5: Monitor for additional walnut pests: mites, aphids, and walnut husk fly.

Secondary pest populations can increase due to the reduction of insecticide sprays in pheromone mating disruption blocks. Mites, aphids, and walnut husk fly, which are potentially economically threatening, were monitored throughout the season in years 1999 to 2002, and were treated as needed in some orchards. Due to reduced funding in 2003, additional pest monitoring was limited to walnut husk fly.

Walnut husk fly was monitored in each treatment block with baited traps. Flies were collected from the traps and examined to determine sex, and females' flies were further inspected to determine if they were gravid. If females with eggs (gravid) were found, then it was recommended that an application of malathion plus bait be made within 7 to 10 days.

A satellite demonstration project was conducted comparing reduced-risk materials for management of walnut husk fly. A high WHF population site in Yuba County was monitored for population increases then split into two treatment blocks. In late July, GF-120 was applied weekly to one block. The other block was treated with Imidan in early August. Nuts were monitored for stings at a rate of 300 nuts/treatment at two different times after treatment. The GF-120 block was supplemented with Penncap-M when WHF sting damage reached the 20% level.

Objective 6: Assess the economic impact of a reduced-risk program as compared to conventional practices.

Accurate economic data was collected on all materials evaluated as well as whatever the grower used to control codling moth. Materials, rates of sprays, number of applications, and application costs were recorded. Many of these reduced-risk materials are not used as readily as conventional materials, so at this time, the cost of reduced-risk materials can be higher than they

may be in the future. However, recording the costs gives us insight into total and comparative costs until products become more widely used and as application methods become refined.

Objective 7: Record pesticide use in commercial walnuts over a 10-year time period.

Data was compiled using the California Agricultural Statistical Service, Pesticide Use Reports from Department of Pesticide Regulation, and University of California IPM Web site. This information is important in order to recognize pesticide use trends and can be used to determine how proactive growers can be in utilizing such reduced-risk alternatives as sprayable pheromone for codling moth or Bacillus thuringiensis.

RESULTS

Objective 1: Continue to build upon the Walnut Pest Management Alliance Team for implementation of reduced-risk strategies and extend the information to growers.

The Walnut Pest Management Alliance Team has been proactive in refining and demonstrating pheromone mating disruption in walnuts, as well as in keeping the information moving from Farm Advisors, to field scouts, and to the end users including growers, PCAs, and BIOS projects. Continuing to publicize the success of reduced-risk practices is the foundation for it to become more widely used. The PMA Management Team continues to lead the organization and research necessary for adoption of these new practices.

A core group of the Walnut PMA Management Team met Jan 23, 2003 during the 35th Walnut Research Meeting in Bodega Bay to make decisions about the treatments to be used in the upcoming year. The Management Team met twice in the fall of 2003 to compare and analyze harvest results and to share ideas for the next season. On November 13, at the UC Cooperative Extension office in Stockton, the Team discussed the preliminary harvest results of the main PMA demonstrations. The PMA management Team conducted a meeting on December 4, specifically to discuss findings of the separate "Value-Added" implementation trials, and invited all the PCAs involved in this portion of the PMA. The meeting was in Modesto at the Stanislaus County UCCE office. These meetings were attended by the Management Team, which includes about 25 members.

Field meetings and workshops are some of the ways information is extended to growers, cooperators, and interested allied industry. 'Advances in Codling Moth Management for Apples, Pears, and Walnuts' was presented three times throughout the state in the first week of March 2003. The attendance was approximately 200 for each meeting. Data from the four years of the Walnut PMA was used by many of the researchers. Due to standardized, replicated trials in various locations, the data that has been collected from the pheromone mating disruption portion of the Walnut PMA is very valuable to the industry. Cover crops were the primary focus of a spring walnut grower meeting in San Joaquin County on March 28, and other topics included management of Walnut Husk Fly, and scheduling of irrigation. An "Innovations in Walnut Orchard Floor Management" Field Day was held August 15, 2003 in Modesto. Subjects covered included techniques for cover crop seeding, establishment, and management as well as the pros and cons of cover crops. Carolyn Pickel presented the results of this year's research and demonstration plots at the 36th Annual Walnut Research Conference in January 2004.

Newsletters and reports are also an important component of outreach and extension for the Walnut PMA. Walnut PMAs cover crop demonstrations were cited as an example of protecting surface water and reducing pesticide runoff under proposed Dormant Spray Water Quality Initiative in the Orchard Notes newsletter from Janine Hasey, October 2003. Results from the 2003 season were reported in the Walnut Research Reports, 2004 "Walnut Pest Management Alliance 2003: Year 5 Update". This report is published annually and made available to all walnut growers.

Objective 2: Demonstrate IPM strategies to control codling moth, *Cydia pomonella.*

In 2003 the Walnut PMA continued to refine and evaluate the use of pheromone-based mating disruption for codling moth management. The five sites monitor different growing conditions across the state as well as acting as replications for the treatments. The replicated trials included treatments of Suterra's CM-F at 10 grams a.i./acre and at 5 grams a.i./acre, and an untreated control. The application protocols for this trial were refined to focus on economic viability for the grower while maintaining a high quality crop by integrating the pheromone into the growers' regular spray program. The pheromone was applied four times, with an interval of 30 days or more. The first application was combined with a blight spray to reduce costs and unnecessary trips through he orchard with the sprayer. The second and/or third application of pheromone was combined with Lorsban (Confirm at the Tehama County site) at a time when the grower is usually applying an insecticide for codling moth anyway. The third application was pheromone only, and the forth (optional) could contain pheromone only, or in combination with insecticide. At each site, the spray timing and addition of insecticide was based on monitoring for in-season damage by evaluating dropped nuts and canopy counts to determine damage level, and on trap counts to follow the generations. The addition of insecticide to the pheromone mating disruption program varied depending on pest pressure, as shown in Table 2.1.

Table 2.1 Walnut PMA 2003 Applications and Approximate Timing

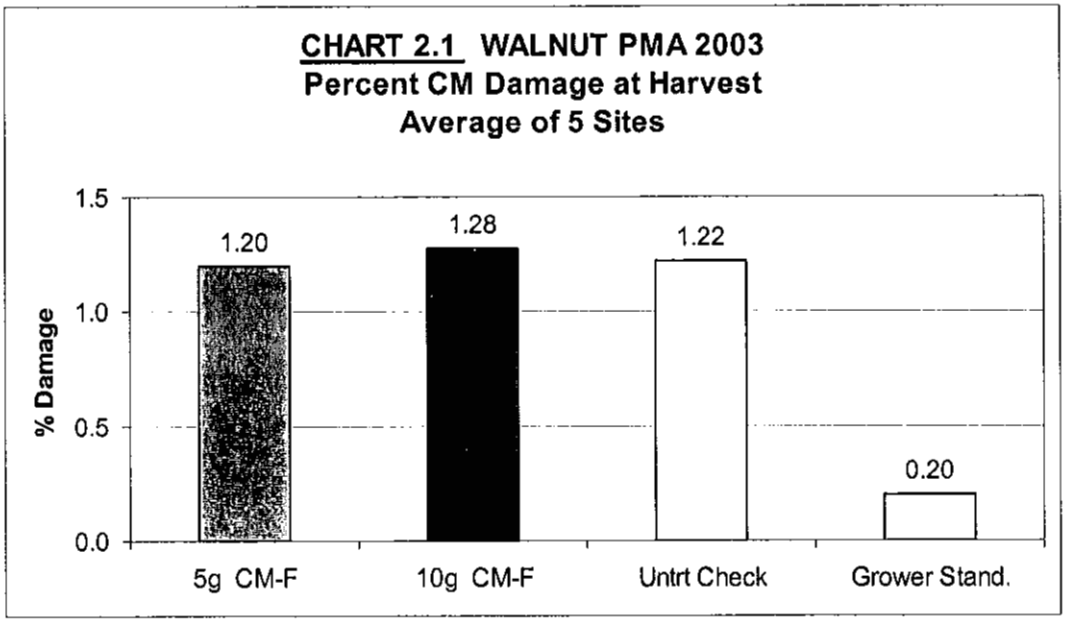
	1	2	3	4
Location	**(April)**	**(May)**	**(June)**	**(July or early Aug.)**
Tehama	CM-F	CM-F	CM-F + Confirm	CM-F
Butte	CM-F	CM-F + Lorsban	CM-F	CM-F
Yuba	CM-F	CM-F + Lorsban	CM-F	CM-F + Confirm
SJ-C	CM-F	CM-F + Lorsban	CM-F + Lorsban	CM-F
SJ-P	CM-F	CM-F + Lorsban	CM-F + Lorsban	CM-F

Harvest damage is used to determine how well each treatment worked, or in other words, how well each treatment controlled damage. Table 2.2 shows the percent damage by treatment for each site and each treatment. Chart 2.1 depicts the average percent damage at harvest per replicated treatment.

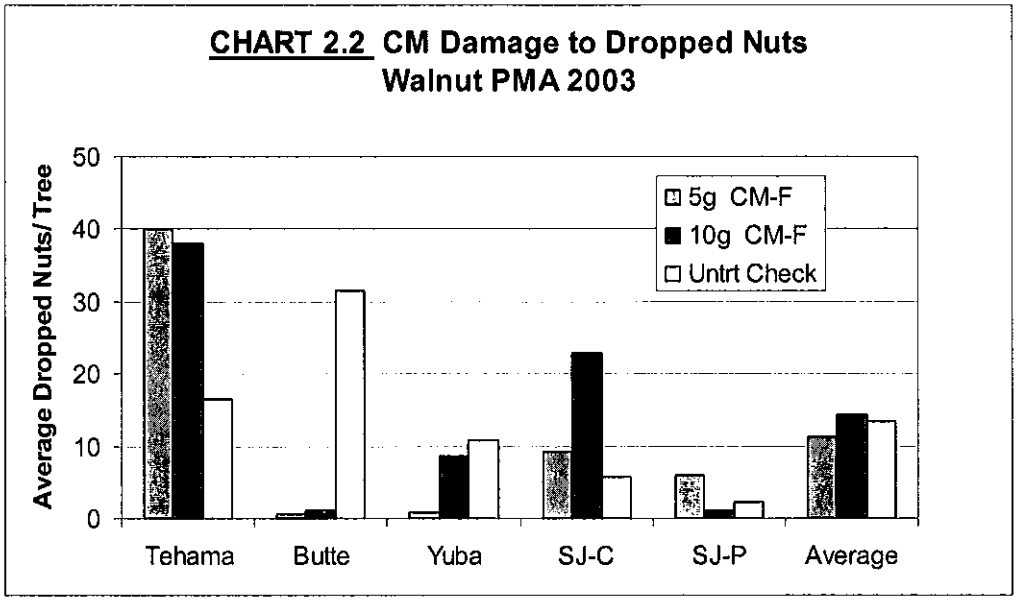
Table 2.2 Percent CM Damage @ Harvest, Walnut PMA 2003

Location	5g CM-F	10g CM-F	Untrt Check	Grower Stand.
Tehama *	2.20	2.40	2.30	-
Butte	2.40	1.40	1.60	0.40
Yuba	0.60	2.20	1.00	0.40
San Joaquin-C	0.00	0.20	0.00	0.00
San Joaquin-P	0.80	0.20	1.20	0.00
Average	**1.20**	**1.28**	**1.22**	**0.20**
Std Dev	1.049	1.055	0.844	0.231

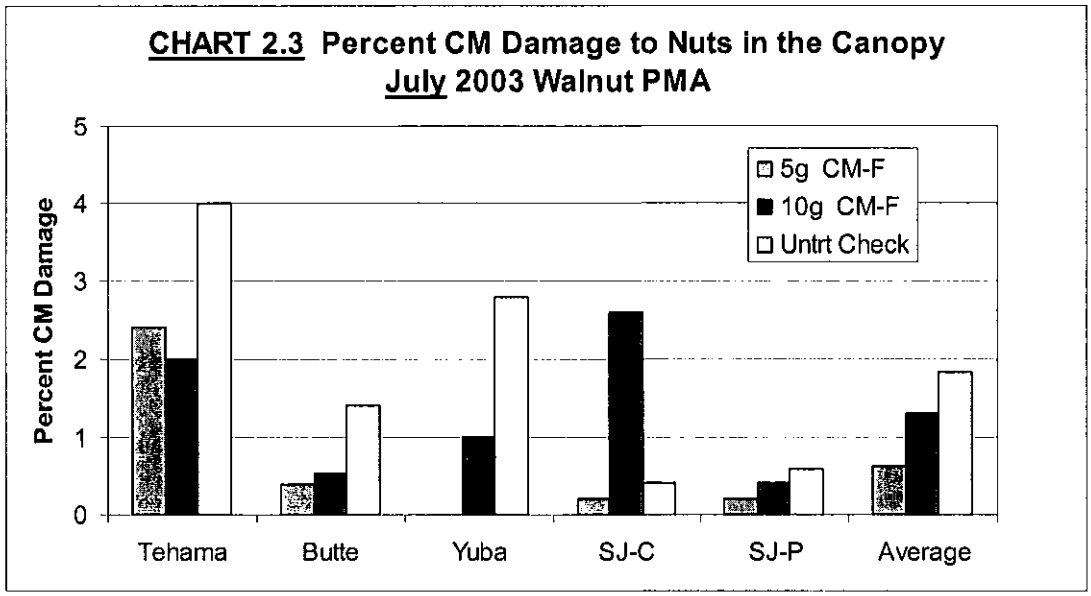
*Tehama: Rep 1 data only

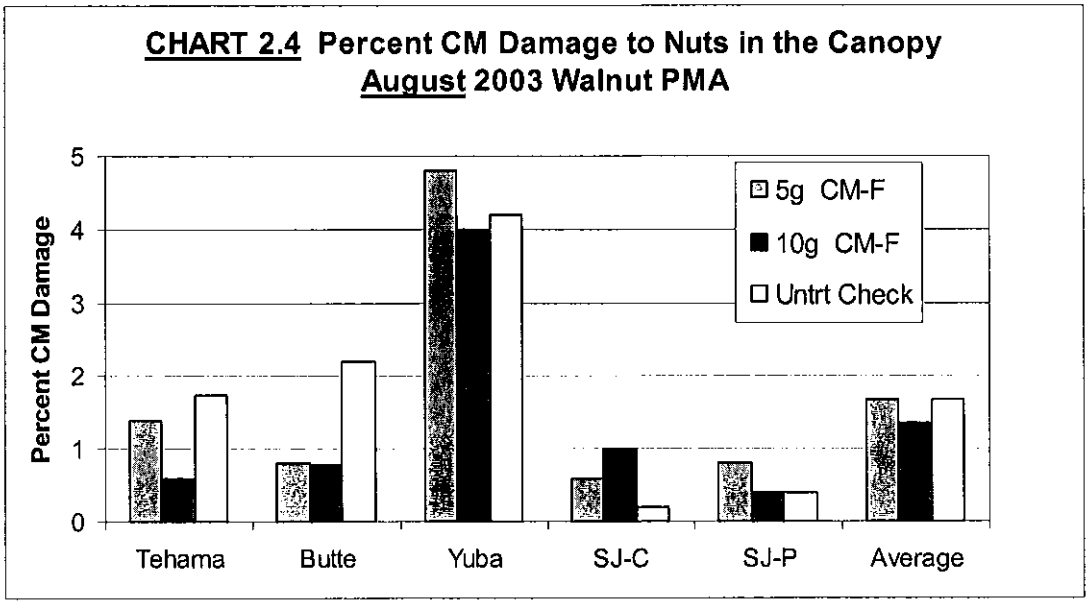


In-season monitoring techniques such as nut drop and canopy counts are tools to aid in determining damage levels at the end of each respective generation and the canopy counts have been good indicators of damage at harvest. Nut drop data is an analysis of the amount of damage from the first generation of codling moth. Each orchard monitored the codling moth infested walnuts that dropped off the five selected trees in middle of each treatment. Weekly, the walnuts under each of these five trees were inspected for codling moth damage, and recorded as average number of damaged nuts per tree, Chart 2.2.

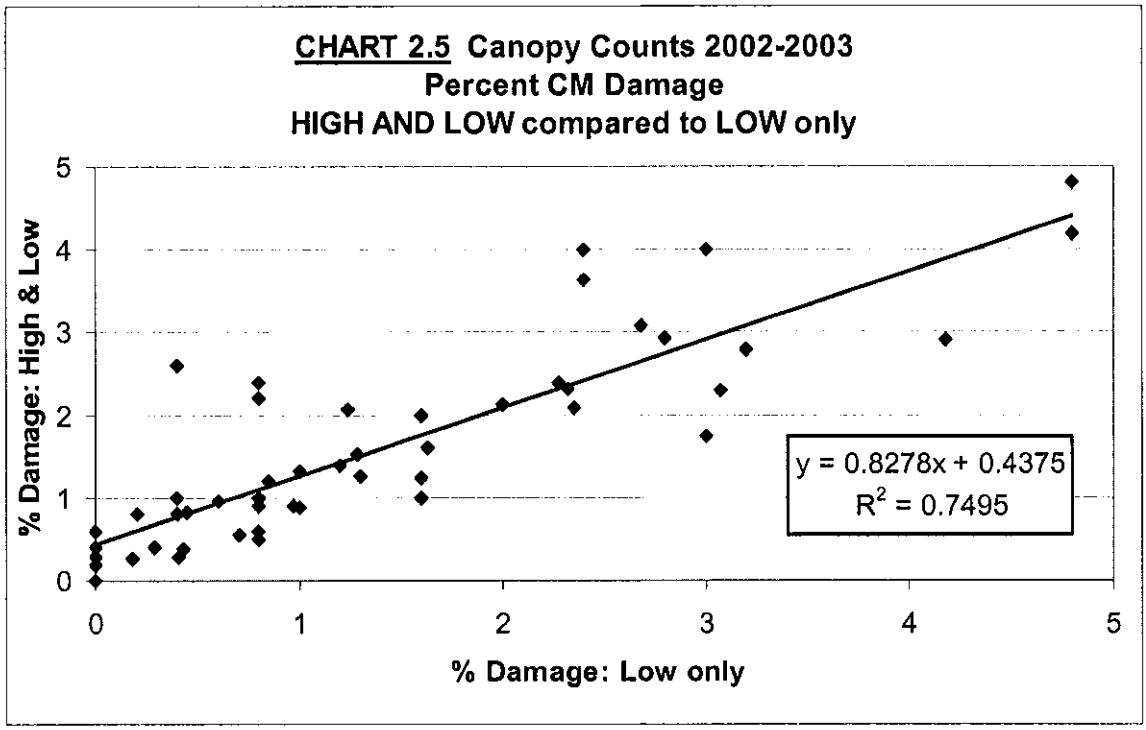


Canopy counts were conducted in all five walnut PMA orchards using the same five trees chosen for nut drop. At the end of the overwintering generation, walnuts in the tree were inspected for codling moth damage, Canopy Count 1, typically in July, Chart 2.3. At each tree, 50 walnuts were randomly inspected low in the canopy and 50 walnuts were randomly inspected high in the canopy using orchard ladders for a total of 100 walnuts per tree, 500 walnuts per treatment. Canopy counts were conducted again in August, at the end of the second codling moth generation, Canopy Count 2, Chart 2.4. They were conducted in the same manner, inspecting walnuts low in the canopy and high in the canopy, using the same trees as for nut drop and the first canopy counts.

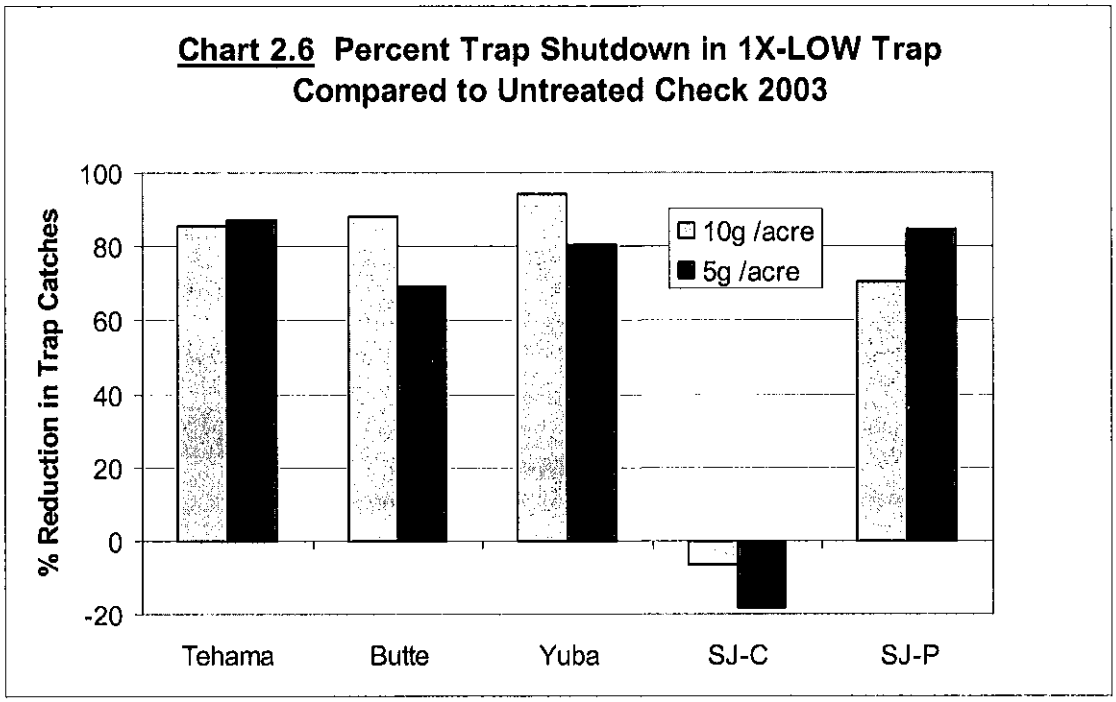




Damage to nuts found in canopy counts is commonly used to determine the need for treatment with an insecticide. In a commercial orchard, however, it is not usually practical to use a ladder to look at lots of nuts high in the canopy. Growers and PCAs need fast reliable monitoring tools. For two years, we have found that data gathered by inspecting nuts only low in the canopy without the use of ladders is not significantly different from the 'high and low' method, Chart 2.5, and could be equally valuable in determining percent damage with reduced time and effort. The 52 data points in Chart 2.5 include 5 cases where a 'low only' canopy count may have resulted in a false negative. In other words, the 'high and low' canopy count showed a damage level over 2%, where a treatment would be considered, but the 'low only' showed damage below 2%.

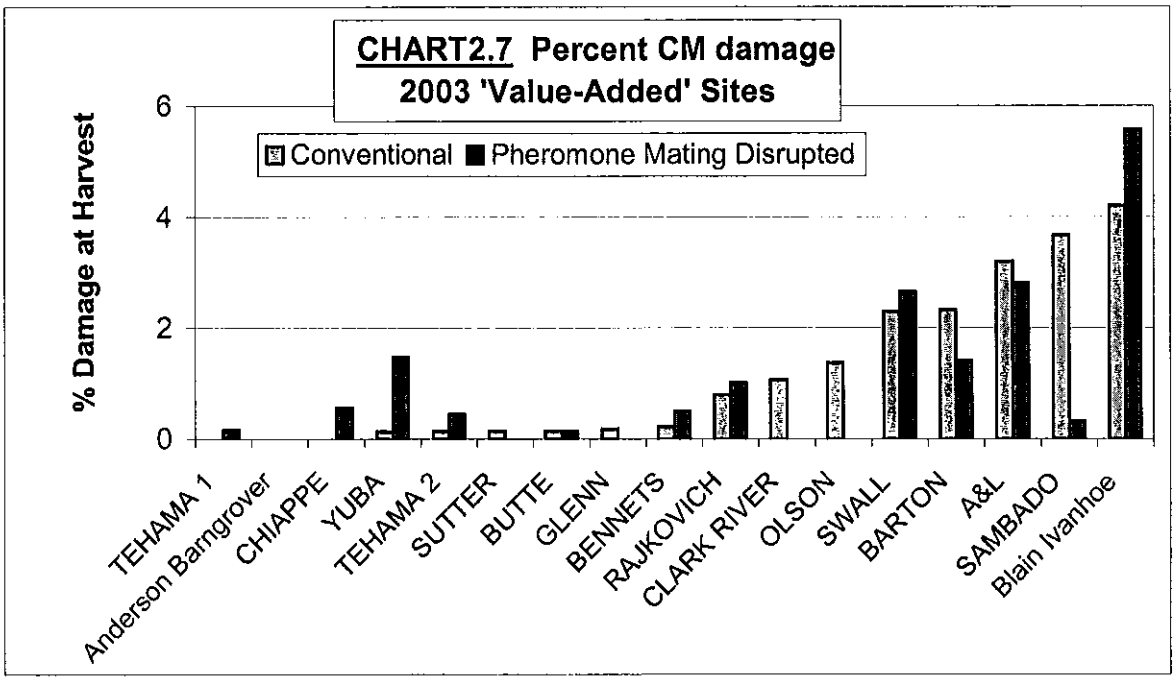


Reduced risk pest management materials often require careful timing of applications. Monitoring with traps gives information about population and progression of generations. Traps placed in the untreated control serve as a comparison to pheromone treatments because the traps in a pheromone-treated orchard will catch very few or zero moths. When the pheromone treatment is working well, "trap shutdown" will be observed in the treated blocks, Chart 2.6.



The portion of this project focusing on extension and implementation included 6 sites in each of the Northern San Joaquin Valley, the Southern San Joaquin Valley and the Sacramento Valley, for a total of 18 implementation plots. These sites compared low rates of pheromone (5 g a.i./acre) plus insecticides against the performance of the same insecticide without the added pheromone. The grower and pest control advisor followed their normal protocols including monitoring with traps, and made all spray decisions. In-season damage was monitored similarly to the main PMA plots mentioned above, using nut drop and canopy counts. Canopy counts were done from the ground only, examining 20 nuts each on 30 trees throughout the block, for a total of 600 nuts. Damage at harvest was assessed with a sample of 100 nuts each from 6 trees per treatment. The harvest samples were sent to the Dried Fruit Association for grading.

The eighteen sites had considerable variation in codling moth populations, as well as different spray timings, materials used, and number of applications made. The orchards with higher pressure from codling moth generally showed the greatest enhancement from the addition of the pheromone, Chart 2.7. In orchards with very low damage in the 'conventional' plots, the advantage from the pheromone supplements was either non-existent or impossible to detect. One orchard was eliminated from the damage estimate given that the pheromone treated portion was adjacent to an apple orchard that traditionally has had very high codling moth counts, thus establishing a known bias within the field.



Objective 3: Demonstrate IPM strategies to control walnut blight, *Xanthomonas campestris*.

The PMA and University of California Farm Advisors conducted three trials to further field-test the Xanthocast walnut blight model and to evaluate it for clarity and ease of use by growers and researchers. There were a total of three treatments in the blight trial: (1) a Manex and Copper treatment at 2% pistillate bloom, then sprays following the Xanthocast model, (2) the grower's standard practice, and (3) the untreated control with no sprays of Manex or Copper.

The Xanthocast walnut blight model's prediction of disease pressure ("blight index") was made available for no cost on the Web site www.Fieldwise.com. The blight index was checked daily for spray recommendations by researchers. This information was passed to the cooperating growers who treated the corresponding blocks as indicated by the model. Due to a malfunction at the nearby weather station, there was no daily blight index for the Riverbank test plot in San Joaquin County to follow. So the treatments at that site were: (1) Grower Standard with Early Spray, (2) Grower Standard with Late Spray, and (3) Untreated Control. At each of the research sites, the treatments were surveyed for blight damage to nuts in June, when the rainy season was over. One thousand nuts per treatment were visually inspected for symptoms of blight infection in the canopy. The results of the various treatments, expressed in percent walnut blight, are shown in Table 3.1.

Table 3.1 Percent Walnut Blight at Three Locations, Walnut PMA 2003

Treatment	Yuba	San Joaquin (Farmington)	San Joaquin (Riverbank)	# of sprays
2% pistillate bloom, plus Xanthocast model	2.67	0.00		4
Untreated Control	20.33	9.40	0.00	0
Grower Standard	1.00	0.00		5
Grower Standard w/ Early Spray(4/11, 4/23, 5/1)			2.00	3
Grower Standard w/ Early Spray(4/11, 4/23, 5/1)			0.00	3
Grower Standard w/ Late Spray(4/22 ,5/1)			2.00	2
Grower Standard w/ Late Spray(4/22 ,5/1)			0.00	2

The Xanthocast blight model has been an accurate predictor of risk of infection, and in 2003, was shown to save one spray application, as compared to a conventional treatment interval of 7-10 days. However, it requires great scheduling flexibility by the grower, and some growers have implied that they prefer the convenience of a pre-planned spray schedule. Starting in 2004, access to Fieldwise.com will be by subscription only, so the blight model will no longer be available free of charge to the grower.

Objective 4: Demonstrate the impact of a replanted cover crop, a naturally reseeding cover crop, and native vegetation.

A cover crop planted four years ago in Yuba County was replanted in December 1999 to augment reseeding after an herbicide application prevented some of the planted species from reseeding in the middle of the rows. Sampling of plant species present in the PMA and grower standard was conducted each year, except for 2003, when the cover crop was mowed early. The sampling was done on a presence/absence basis, recording only whether species were present. Of the species originally planted in the PMA blocks, the blando brome and the sub clover populations increased, and the medic population remained the same. Pink nitro, crimson clover, and vetch did not establish as well, as their numbers were decreasing.

Objective 5: Monitor for additional walnut pests: mites, aphids, and walnut husk fly.

Due to decreased funding levels for field assistants, monitoring for secondary pests was greatly reduced. Regular monitoring with baited traps was done for walnut husk fly, but weekly surveys for aphids and mites were discontinued. Three of the five replicated PMA sites were treated with Omite, one was treated with Apollo, and one was not treated for mites.

Walnut husk flytraps with ammonium carbonate bait were placed in each treatment block in early July and checked weekly. The number of male, female, and gravid female flies were identified, recorded and removed. A treatment was recommended to the grower if any gravid females were found, or if the total numbers of WHF began to increase sharply. Malathion (4 pts/ac) + bait was applied to the two pheromone treatment blocks and the untreated control at the Yuba site August 21 due to an increase in total trap catches.

WHF Satellite Project

A demonstration project was conducted comparing reduced-risk materials for management of walnut husk fly. A high WHF population site in Yuba County was monitored for population increases then split into two treatment blocks. Starting July 25, a new reduced-risk material, GF-120, was applied weekly for four weeks, to the east block. The west block was treated with Imidan August 1. Nuts were monitored for stings at a rate of 300 nuts/treatment on August 18. Due to a high numbers of walnut husk fly stings in the GF-120 block, that section was supplemented with Penncap-M on August 19. The other block received a second application of Imidan, also on August 19. A second survey for WHF stings was conducted on August 29, see Table 5.1.

Table 5.1 Percent Damage from Walnut Husk Fly at Satellite Trial, Yuba County 2003

Survey date	Treatment	# nuts w/WHF stings	# nuts examined	% damage
18-Aug	Imidan	4	333	1.20%
18-Aug	GF-120	41	300	13.67%
29-Aug	Imidan	8	300	2.67%
29-Aug	GF-120 + Penncap-M	64	300	21.33%

Adequate control of walnut husk fly was not achieved with GF-120 alone for two reasons. At this trial, the GF-120 was applied when the traps showed a population increase, but according to UC researchers and representatives of Dow AgroSciences, it should have been applied when the first walnut husk flies were first caught in the traps. Also, GF-120 works better in lower populations, but this orchard started with a high population of WHF. We have also learned from Jim Stewart, walnut PMA cooperating PCA in the lower San Joaquin Valley, that GF-120 is effected by humidity and works best when used at 1:1.5 mix with ¼ inch nozzles instead of the 1:4 recommended by Dow with 1/8 inch nozzle. The label states a wide range of mixes.

Objective 6: Assess the economic impact of a reduced-risk program as compared to conventional practices.

At the five main PMA sites, the pheromone was applied four times at intervals of more than 30 days beginning just after biofix, or shortly thereafter, when the trees began to leaf out. The Suterra product was used with one of the recommended sticker-spreaders, NuFilm-P or NuFilm-17 at 6 oz per acre. Lorsban or Confirm was added to the spray tank during the pheromone application either one or two times, depending on codling moth pressure at each site. Representatives of Suterra quoted the cost of CM-F, the sprayable pheromone, at approximately $2.00/gram. Suterra donated the product used for this project. Table 6.1, below, shows the materials only cost of one application.

Table 6.1 Cost of **Materials** used in the Walnut PMA 2003

Material	rate/ac	$/ac
CM-F	5g	10.00
CM-F	10g	20.00
NuFilm	6 oz	0.72
Lorsban	4 pt	22.36
Confirm	1 pt	22.00

The treatments were all applied with an airblast orchard sprayer. The total cost per acre to use the sprayer is $15.57, which includes labor, fuel, lube, and repair. The typical hourly pay for skilled labor to use the sprayer is $9 per hour. With the addition of payroll taxes and insurance, the cost to the grower is $12.06 per hour. These costs were taken from "UC Extension Sample Costs to Establish a Walnut Orchard and Produce Walnuts, 2002" available at http://www.agecon.ucdavis.edu/outreach/crop/cost-studies/WalnutSac2002.pdf. Table 6.2 below shows the TOTAL costs (includes materials and application cost) per acre for all of the treatments used. The cost for Lorsban and Confirm are very similar, and are interchangeable in this table.

Table 6.2 **Total** Costs per Acre for Treatments used in the Walnut PMA 2003

	# of applications	Lorsban/Confirm added?	Total $/acre
CM-F @ 5g a.i./acre	4	0	105.16
CM-F @ 5g a.i./acre	4	1	127.16
CM-F @ 5g a.i./acre	4	2	149.16
CM-F @ 10g a.i./acre	4	0	145.16
CM-F @ 10g a.i./acre	4	1	167.16
CM-F @ 10g a.i./acre	4	2	189.16

There were a wide variety of grower standard treatments. Not all the sites included a grower standard comparison treatment. For comparison, the 2002 UC Cost Study for walnuts lists the costs for codling moth control at $87 per acre. The cost of some mating disruption products may change as the products become more widely used.

Objective 7: Record pesticide use in commercial walnuts over a 10-year period.

The results presented in this section were acquired from the Internet Web sites of the California Agricultural Statistical Service, www.nass.usda.gov/ca, and the California Department of Pesticide Regulation Pesticide Use Reports www.cdpr.ca.gov/docs/pur. Walnut acreage has fluctuated over the last dozen years, resulting in a slow but steady increase. Due to the fluctuation in the number of acres, applications to California walnuts are all summarized here as pounds per acre. Pesticide use in walnuts has been on the decline, 2001 being the lowest use, Chart 7.1., but increased again in 2002, probably due to increased pressure from walnut blight and codling moth. Organophosphates, pyrethroids, carbamates, and *Bacillus thuringiensis* are also summarized separately in this section. The use of pheromone mating disruption products is also reported to the Department of Pesticide Regulation, the active ingredient (E,E)-8,10-Dodecadien-1-ol is the only one listed in the 2002 Pesticide Use Reports, Chart 7.2.

Chart 7.1 Total Pesticides Applied to California Walnuts

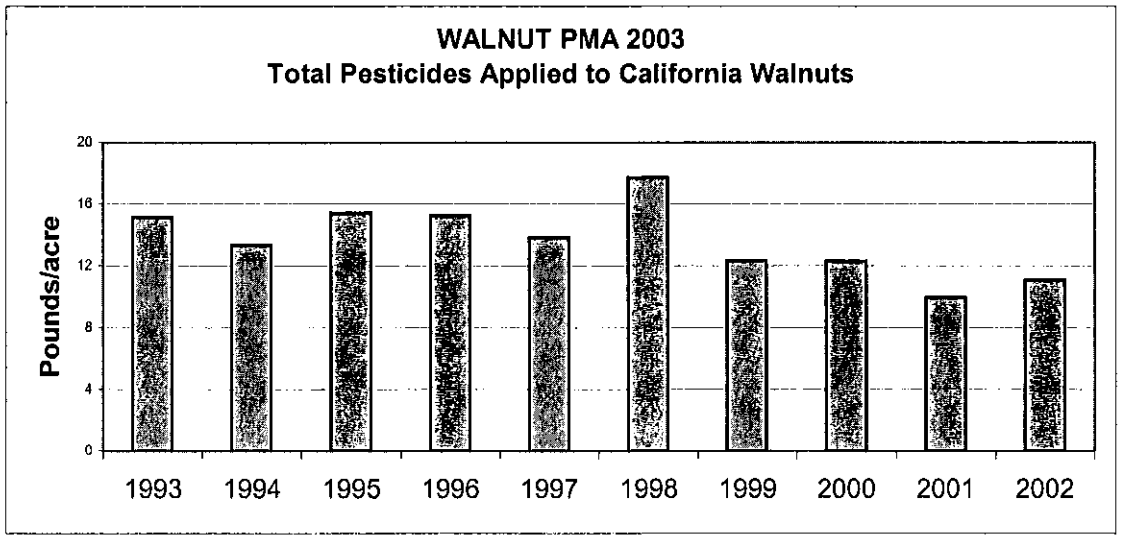
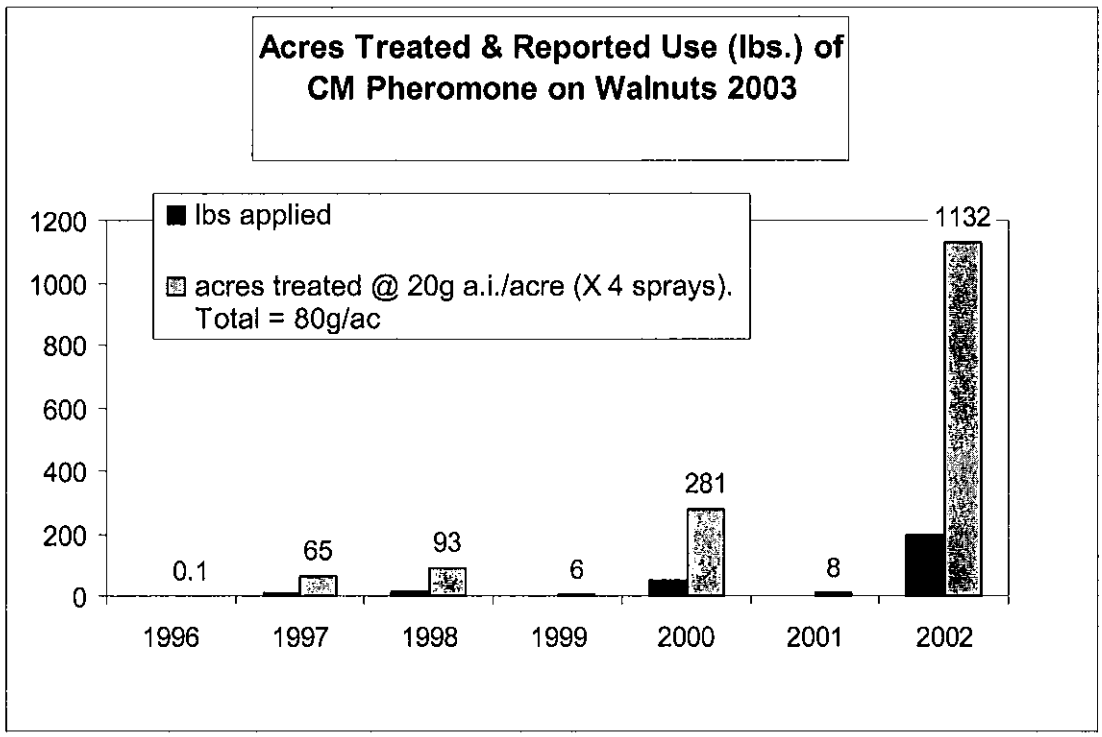


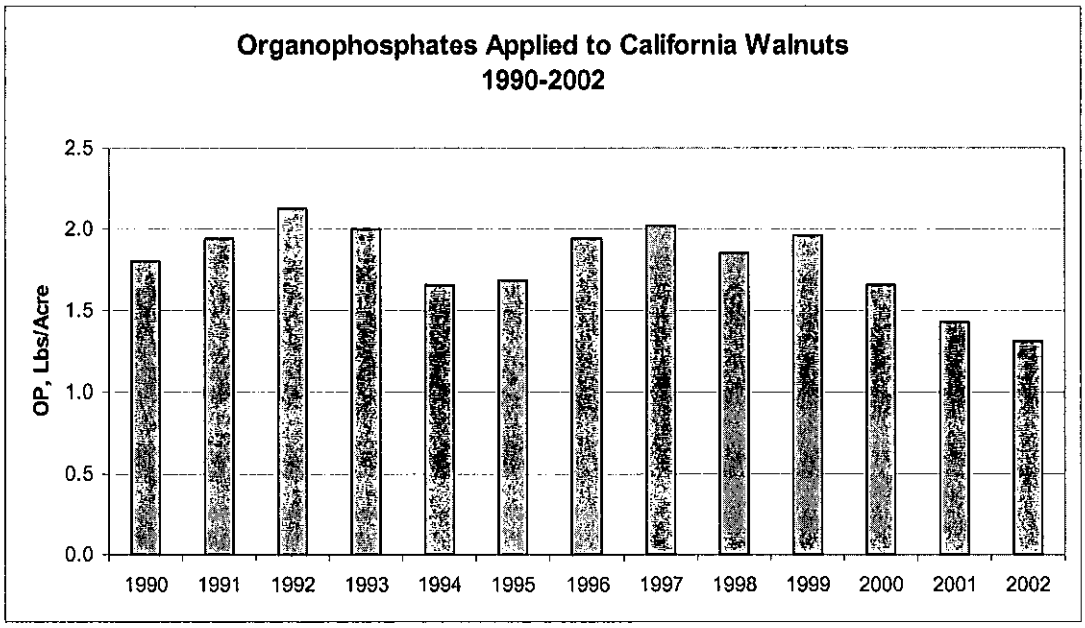
Chart 7.2 Codling moth pheromone applied to walnuts in California.



Organophosphate

The organophosphates used to determine the following were: azinphos-methyl, chlorpyrifos, diazinon, malathion, methidathion, methyl parathion, naled, oxydemeton-methyl, phosalone, phosmet, phosphamidon, and phosphamidon related products. Statewide applications over the last eleven years are shown in Chart 7.3, below. The year 2002 had the lowest amount of organophosphates applied since 1990. Growers applying these products are doing so because of the potential for economic loss due to codling moth. Organophosphates are cholinesterase inhibitors, one of the most toxic classes of pesticides, and are of high regulatory concern.

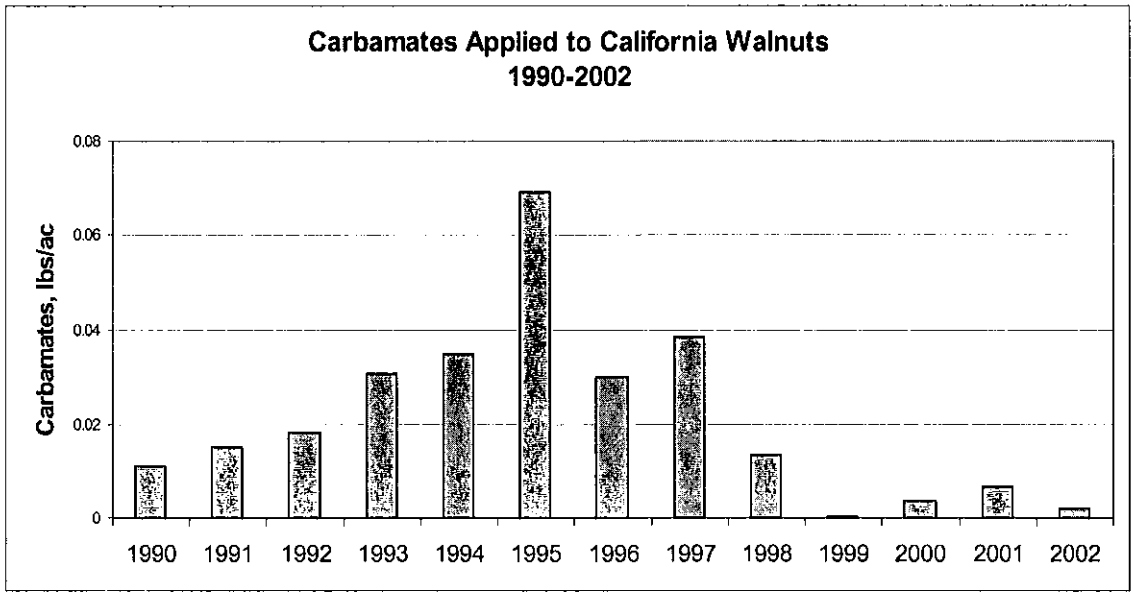
Chart 7.3 Organophosphates Applied to California Walnuts, Pounds per Acre



Carbamates

The carbamates evaluated for this report are carbaryl and methomyl. Carbamates are also cholinesterase inhibitors, affecting the central nervous system. Carbamate use is at a very low point since peak use in 1995, Chart 7.4.

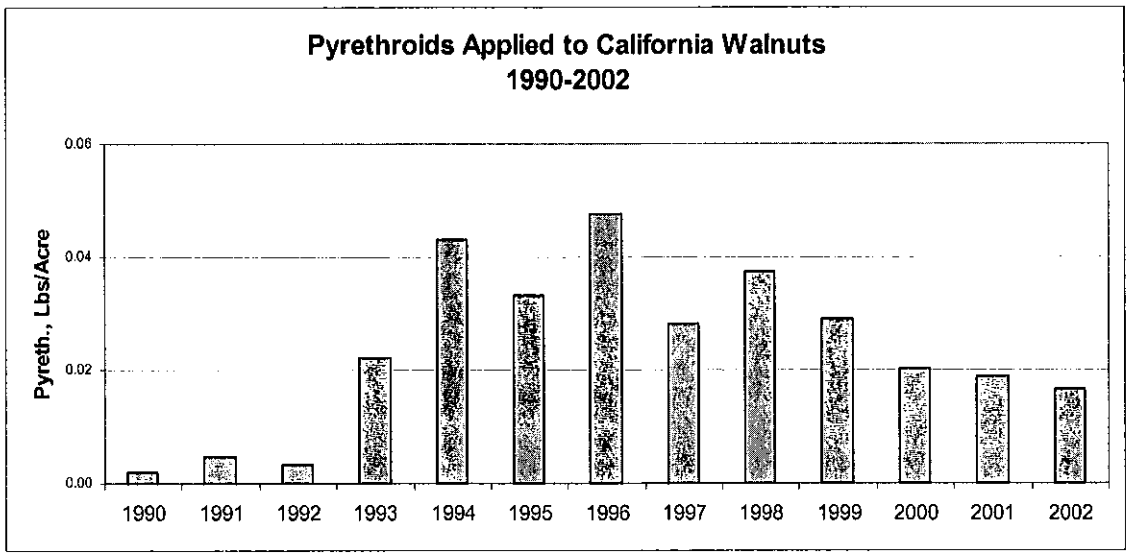
Chart 7.4 Carbamates Applied to California Walnuts, Pounds per Acre



Pyrethroid

Esfenvalerate and permethrin were the materials included in this summary. Statewide applications are shown in Chart 7.5. Pyrethroids are used throughout the growing season for several pests. The amount of pyrethroids used in California walnuts has been on a slow decline since peak use in 1996.

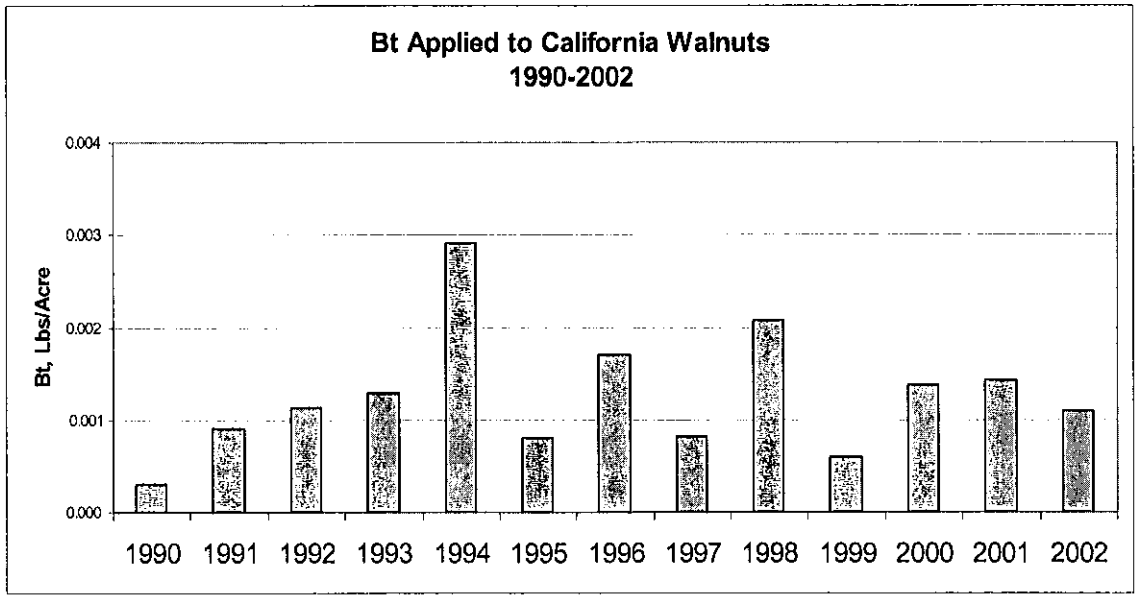
Chart 7.5 Pyrethroids Applied to California Walnuts, Pounds per Acre



Bacillus thuringiensis(Bt)

In the Early 1990's, there was very little use of Bt. In 1994, there was a large increase in pounds per acre applied. Since then, Bt use seems to rise and fall in alternating years, but without reaching the peak usage of 1994, Chart 7.6.

Chart 7.6 Bt Applied to California Walnuts, Pounds per Acre



DISCUSSION

The walnut PMA has maintained a strong alliance between the industry, UC researchers, UC farm advisors, BIOS partners, grower cooperators and PCAs. This year, the PMA narrowed its focus to the pheromone mating disruption technology that will fit most easily into growers current spray programs and began the implementation phase with 18 field trials. Now that the alliance has developed and demonstrated reduced-risk practices, we can reach more growers by increasing the number of field trials. The alliance has been instrumental in serving as a communication body between all groups interested in reducing the reliance of pesticides in walnuts. It has helped direct and attract research funded by the walnut board that is directly relevant to the needs of developing economic reduced-risk practices for growers. The farm advisors and BIOS project managers have been able to participate and keep abreast of the reduced-risk practices which they can quickly extend to their local BIOS and extension programs. The walnut PMA has been able to attract additional researchers to the project since its inception. These include Dr. Steve Welter and Dr. Doug Light. The data collected by the PMA and extended to the walnut industry is an information base, which has made possible the move into implementation of this new technology. The added visibility of additional projects greatly enhances the adoption of pheromone mating confusion by even more growers, thereby reducing insecticide sprays. In 2004, the PMA intends to continue the implementation trials incorporating new cooperators. These projects are an important step, because they include the PCA and the grower who will be the ultimate end user. At the same time, they will be learning how to monitor the effectiveness of mating disruption so there is little risk to the grower. The walnut PMA has been able to reach their goals of incrementally demonstrating a successful mating disruption program and to see emerging application technologies become commercially available that will be much easier for walnut growers to adopt.

The blight demonstration program has moved along faster than originally planned with the Xanthocast Model becoming available to Sacramento Valley growers through Fieldwise.com and funded by Griffin LLC. In 2002, the PMA had three walnut blight trials across the state to evaluate the Xanthocast model. The PMA also worked more closely with growers to learn to interpret the model more specifically for their situation. In 2003, there was finally enough rainfall to cause some blight damage, making the trails more meaningful. This follows three years with such a low incidence of rainfall that resulted in low walnut blight damage with no significant differences between treatments. Results look promising for growers to have a tool to help them reduce the number of applications for blight control.

Project Summary Form 2003

1) Proposal Title
A Reduced-Risk Management Program for Walnuts
2) Principal Investigator
Dennis Balint, Walnut Marketing Board
3) Alternative Practices
Intensive in-season monitoring to determine pest pressure and spray timing and pheromone mating disprution applied with existing spray equipment to control codling moth. Vegetation management (i.e. cover crops) to suppress winter weeds, prevent erosion, prevent pesticide runoff, improve water filtration, and increase biodiversity. Disease forecasting and other IPM strategies to control walnut blight.
4) Summary of Project Successes:
Mating disruption materials have been shown to provide effective control of codling moth statewide, including the sprayable formulation. Replicated treatments statewide allow statistical analysis of results. Development of monitoring guidelines for use in a reduced risk pest management system. PMA has built a positive relationship with growers who allowed unsprayed controls in their commercial orchards. Research has developed and demonstrated a walnut blight forecast model to help reduce the number of applications to manage blight.
5) Number of Participating Growers: 20
6) Total Acreage in Project: 1008 acres (main PMA sites=288 ac, plus value-added=720 ac
7) Project Acreage under Reduced Risk: approximately 495
8) Total Acres of Project Crop: Unknown
9) Non-Project Reduced Risk Acres: Unknown
10) Number of Participating PCAs: approximately 15
11) Cost Assessment: Materials only cost is shown, as well as TOTAL cost, which includes materials, equipment and labor. The last three entries on the table below are options for "conventional" pest management, the first three entries are pheromone mating disruption. See Task 6 for more detail.

MATERIALS	RATE	# OF SPRAYS	SUB TOTAL(materials only)	**TOTAL**
CM-F + NuFilm-P	5g - 10g 6 oz	4	$44 - $84	**$105 - $145**
CM-F + NuFilm-P Lorsban/ Confirm	5g - 10g 6 oz 4 pt/ 1 pt	4 1	$44 - $84 $22.00	**$127 - $167**
CM-F + NuFilm-P Lorsban/ Confirm	5g - 10g 6 oz 4 pt/ 1 pt	4 2	$44 - $84 $44.00	**$149 - $189**
Asana	1 pt	1	$17.00	**$32.57**
Lorsban/Confirm	4 pt/ 1 pt	1	$22.00	**$37.57**
Lorsban/Confirm	4 pt/ 1 pt	2	$44.00	**$75.14**

12) Number of Field Days: 2
13) Attendance at Field Days: approx. 160
14) Number of Workshops & Meetings: 3 codling moth workshops, & 2 PMA Advisory Team meetings
15) Workshop Attendance: about 600 (plus about 50 for the Advisory Team meetings)
16) Number of Newsletters:
17) Number of Articles: 1 article about cover crops, Farm Advisor newsletter
18) Number of Presentations: 3. Walnut PMA information presented at San Joaquin field day March 28, 2003 and also Modesto august 15, 2003. PMA data and results presented at 36th annual walnut meetings in Bodega Bay in January 2004.

FOR OFFICIAL USE ONLY Contract Number Project ID
DPR ID# Contract Manager *25th June 2001 Version*

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